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The Permeability of Certain of the Sensory Hairs on the Antennae of Lacewings (Neuroptera: Chrysopidae)

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INTRODUCTION

Slifer (1954) reported that the largest of the basiconic sensilla which are present on the antennae of grasshoppers are permeable at the distal tip to aqueous solutions of dyes, such as acid fuchsin, both in the living condition and in preserved material. Trichoid sensilla and two smaller types of basiconic sensilla as well as coeloconic sensilla present on the antennae were found, at that time, to be unaffected by the dye. Later, coeloconic sensilla were found by Slifer (1955) also to be permeable at the distal tip to a dye solution. In 1956, Slifer reported that two smaller types of basiconic sensilla were permeable to dyes, though not at the distal end of the sense organ, but at or near the base of the peg. The evidence presented indicates either (1) that the waxy or lipoid layer of the cuticle which imparts the property of impermeability must be missing from the tips of the largest basiconic sensilla and from a small area near the base of the smaller pegs, or (2) that the entire cuticle must be missing in these areas in the grasshopper. Slifer (1954, p. 127) states that: "Whether insects other than grasshoppers also possess basiconic pegs which are permeable to water and dyes is not known with certainty at present. A few adults belonging to other orders (Collembola, Thysanura, Dermaptera, Isoptera, Neuroptera, Coleoptera, Hymenoptera and

Diptera) were tested with interesting but inconclusive results." It is the purpose of this paper to show that in the living lacewing the distal end of certain of the sensory hairs present on the antenna is permeable to aqueous solutions of a dye.

The sense organs which are present on the antenna of the lacewing, *Chrysopa perla* Linnaeus, were described by Hauser (1880) as tactile bristles (*Tastborsten*) and pegs (*Zäpfchen*). Ruland (1888) described curved or arched pegs (*knieförmig gebogenen Zäpfchen*) which are present on the antenna of the same species. Röhler (1906) briefly reviewed the literature concerning neuropteran antennal sense organs and stated that in 1894 Nagel found the curved or arched pegs only at the distal end of each subsegment of the flagellum and noted nearby the presence of fine or fragile (*äusserst zarte*) hairs.

Materials and Methods

Three species of adult lacewings—*Chrysopa oculata* Say, *Chrysopa plorabunda* Fitch, and *Chrysopa nigricornis* Burmeister [1]—were used in this study. Males and females were caught in the field and tested in the laboratory. Also, individuals of *C. plorabunda* and *C. oculata* were reared in the laboratory and tested just after emergence from the pupal cases in order to eliminate the possibility that the cuticle of the sense organs had been damaged in any way, and so made permeable to the dye. Directions for raising chrysopids are given by Smith (1937).

The method used to demonstrate the permeability of certain of the sensory hairs is that of Slifer (1954). Essentially it consists in bringing the living antennae into contact with a dye in aqueous solution for periods ranging from 15 minutes to 12 hours, dehydrating and clearing the antennae very rapidly, and mounting the antennae whole in resin. All experiments were performed at room temperature. Whole individuals which had been immersed in the stain as long as an hour showed complete recovery after removal, indicating that the tests are valid, as stated, for living material.

[1] The author wishes to thank Dr. W. E. Bickley, University of Maryland, who kindly made the species identification.

Results

Chrysopid antennae are long and thread-like and, in the species examined, ranged in length from 8 to 14 mm. The number of flagellar subsegments is large and an individual may have as many as a hundred. A camera-lucida drawing of a typical subsegment of *Chrysopa plorabunda* (fig. 1) shows the arrange-

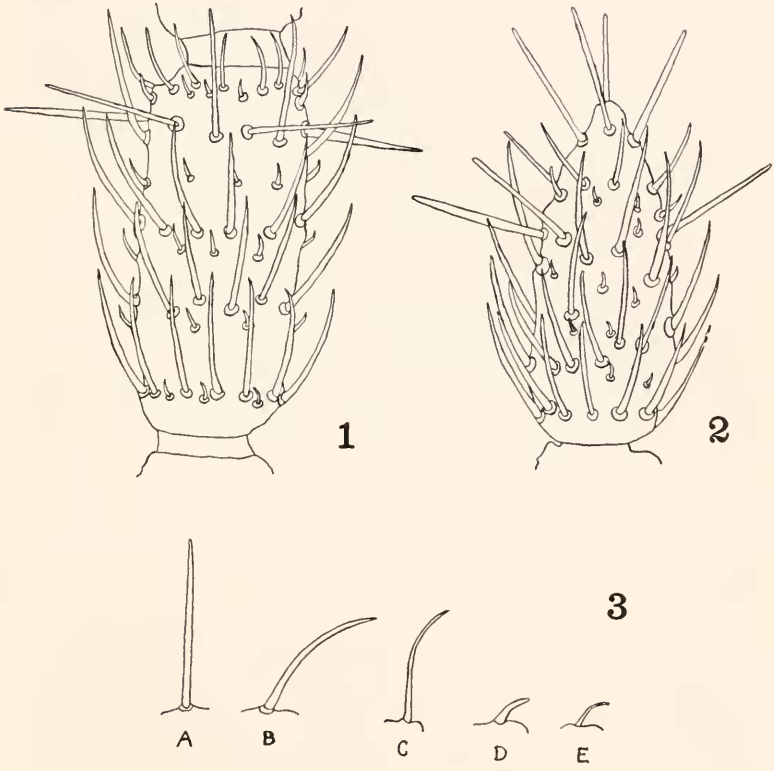

Fig. 1. A typical subsegment of *C. plorabunda* antenna showing the several types of sense hairs present. Long permeable hairs are in transverse row near the anterior end of subsegment. × 350.

Fig. 2. Terminal flagellar subsegment of *C. plorabunda* showing sensory hairs and the two transverse rows of long permeable hairs near anterior end. × 350.

Fig. 3. The five types of hairs found on lacewing antennae. *A* is permeable hair. The other types are apparently unaffected by the dye. × 350.

ment of the several types of sense organs present on it. Those of *C. oculata* and *C. nigricornis* are very similar. No differences between the antennae of males and females were noticed, either in the number of sense organs present, or in their distribution.

Sensory hairs on the antennae which have been found to be permeable at their distal tips to aqueous solutions of dyes are slender structures, 50 to 60 microns long, and are found only near the distal end of each flagellar subsegment. They are about 2.5 to 3 microns in diameter. A row of six hairs encircles each subsegment. They are spaced evenly around the surface of the subsegment. The hairs project outward from the surface in a plane nearly perpendicular to the long axis of the antenna. They are semi-transparent and their walls appear to be thin. Figure 3, a, shows a typical hair which is of the type described. When the antennae of living adult lacewings are brought in contact with an aqueous solution of acid fuchsin, treated and mounted on slides as described above, and then examined under a microscope, the tips of these hairs will be found to have retained some of the red stain. Only the distal end of the hair is colored, indicating that the dye has entered the structure at the tip. The remainder of the sense organ and the antennal surface are unaffected by the dye, except in instances where obvious damage to the cuticle has occurred. Other types of sense organs which are present on the antennae and in which, as yet, no permeable areas have been found are shown in fig. 3, *b, c, d,* and *e.*

The degree of penetration of the dye into the hair is affected by the time that the antenna is allowed to remain in contact with the dye solution. The stain enters the hair rapidly at first and then more slowly as evidenced by the fact that antennae immersed in the dye for varying periods of time up to two hours show the permeable hairs to be stained about the same amount. Periods of exposure over two hours show that the dye has diffused slowly down into the hair from the tip but usually not more than two or three microns after exposure for 12 hours. Adults tested shortly after emergence in the laboratory showed the same results as did the insects caught in the field. This

indicates that the penetration of the dye is not due to a damaged or abraded cuticle.

The terminal flagellar subsegment of an antenna of *C. plorabunda* is shown in fig. 2. The most notable difference between this subsegment and the typical subsegment in fig. 1 is the number of permeable hairs at the tip of the former. As in many insects, the tip of the flagellum in this species is more specialized than are the other antennal subsegments. The hairs at the tip of the terminal subsegment stain very readily in the dye solution. These hairs are of the same general size and structure as the permeable hairs described above. The tip of the flagellum usually contains at least six of these hairs in addition to the regular circle of six which is found in its normal location on the subsegment.

Discussion

The experimental evidence presented by Slifer (1955) for the long, permeable basiconic sensilla of the grasshopper suggests that they may serve as receptors for the common chemical sense and this may be true for the permeable hairs on the lacewing. These sensilla are permeable only at the distal end to solutions of a dye and so resemble the permeable hairs described on the grasshopper. The permeable hairs on the lacewing are located favorably for the reception of tactile stimuli and long, slender, movable hairs of this type are commonly believed to be tactile in function. It is possible that these hairs may have a dual function, i.e., they may respond both to touch and to chemicals as Dethier (1955) suggests for certain of the sense organs on the labellum of *Phormia*.

Summary

1. A description of the antennal subsegments and of the sense organs on the antennae is given for *Chrysopa oculata* Say, *Chrysopa plorabunda* Fitch, and *Chrysopa nigricornis* Burmeister.

2. Certain of the sensory hairs on the antennae are permeable at their distal tips to aqueous solutions of acid fuchsin in the living condition.

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Another New Generic Entity of the Gerridae (Heteroptera)[1]

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We have in the Francis Huntington Snow Museum of the University of Kansas three apterous specimens of a gerrid, two males and one female, that came from Sretensk, Siberia, and were determined as *Gerris brachynotus* Horváth by Dr. A. N. Kiritschenko. *Gerris brachynotus* was described from Gabritza, Eastern Siberia.

At the present time we are unable to examine the type and cannot therefore verify the determination. However, we are convinced these three specimens are not congeneric with Gerris and should be described as a new genus.

[1] Contribution No. 1,017 from the Department of Entomology, University of Kansas. This study is a by-product of a project aided by a grant from the National Science Foundation.